

# The lean legacy of freshwater phycology in Victoria

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## Abstract

An ideal floristic legacy would entail: 1) the preservation and accessible storage of suitable voucher specimens, 2) the accurate description and illustration of taxa, and 3) the classification of these entities into a coherent taxonomic system. All three aspects are generally absent from the published records of freshwater macroalgae from Victoria. To illustrate this, the problems associated with archival preservation and the classification of macroalgae are outlined, followed by a brief history of the collectors. Against this background, the attempts of Henry Watts (1828–1889), Alfred Hardy (1870–1958) and Heinrichs Skuja (1892–1972) to capture the macroalgal flora of Victoria for perpetuity are evaluated. Although Skuja, a professional freshwater phycologist, died leaving a trail of red algal manuscript names throughout the world's herbaria, he produced an elaborate description of a new genus and species from the Yarra River. The naturalists Watts and Hardy seldom achieved all three aspects of a good legacy. Their distributional data for genera has some historical value, but as most of their specific determinations of macroalgae cannot be confirmed, the legacy is of limited scientific value.

Inland Victoria has a diverse abundance of algal habitats; wherever there is water, no matter how transient, there are algae present. On the other hand, collectors and collections of these algae have been rare.

In this paper, I discuss the major collectors and chroniclers prior to 1939, of Victorian freshwater algae (the Charophyta have not been considered here, since they are usually included in aquatic planktonic floras and seldom reported in algal surveys). In particular, I focus on the macroalgal flora and its three main exponents: H. Watts, A. D. Hardy and H. L. Skuja.

## Macroalgal taxonomy and preservation

For convenience, algae can be divided into the microalgae — which are often planktonic — and the macroalgae — which are visible in the field and usually attached to the substratum. Unlike Australian terrestrial and marine floras, most freshwater macroalgae seem to be cosmopolitan. The freshwater macroalgae range from unbranched filaments (e.g. *Klebsormidium* Silva, Mattox & Blackwell, *Spirogyra* Link), through branched filaments (e.g. *Cladophora* Kützing, *Stigeoclonium* Kützing) or branched siphons (i.e. with no cross walls; e.g. *Vaucheria* DC.), to more complex arrangements of whorled laterals (e.g. *Batrachospermum* Roth). All major divisions of algae are represented, but the Chlorophyta are most common. Most genera are distinct and can be identified in the field by an experienced collector. In some genera (e.g. *Cladophora*, *Klebsormidium*, *Batrachospermum*), species are characterised by vegetative or reproductive features usually visible in field material. In other genera (e.g. *Oedogonium* Hirn, *Spirogyra*, *Vaucheria*), reproductive features are of prime taxonomic importance, but many populations (particularly those from flowing water) are often sterile. In *Stigeoclonium*,

recent taxonomic revisions utilize the germination mode of zoospores and the morphology of the prostrate system, neither being visible in naturally growing plants, to distinguish species. The identity of many macroalgae, therefore, remains obscure unless collecting has been fortuitous or plants are grown in culture.

Some of the specific characters remain in dried plants, while others are only retained in wet or slide material. Fresh material must be examined to reveal intracellular cell details, such as chloroplast shape or the presence of contractile vacuoles.

Macroalgae are best preserved as a permanent slide — e.g. mounted in corn syrup, which sets relatively hard, or in sealed glycerol — or in a liquid fixative. If the preserving solution contains some glycerol then the features will remain useful even when the liquid has evaporated. In any case, a dried specimen in a jar is often as good as, or sometimes better than, one absorbed into a piece of paper. A solution of formalin, acetic acid, alcohol and glycerol gives better preservation of features and less dissociation of cells than the commonly used 4% formalin. An air-dried specimen in a cellophane bag usually is the best way to store dried material, but plants pressed onto absorbent paper may be useful where their gross morphology is taxonomically important. So, plants *can* be preserved for a very long time. In most cases, however, good illustrations and descriptions of fresh or wet-preserved material provide an adequate (and often better) substitute.

## Taxonomic legacy

For freshwater macroalgae, as for all plants, there seem to be three aspects of an ideal floristic legacy. Few older treatments would have them all, but at least one of these features is needed: 1) plants should be pre-

served for posterity, with full details of their collections, 2) the specimens should be described and illustrated so that similar plants can be recognized in later collections, and 3) the taxa described should be referred to a universal classification system that shows their relationships with other taxa. Few published accounts of freshwater algae from Victoria achieve any of these features.

### The beginnings of freshwater algal studies in Victoria

In the frontier days of freshwater algal collecting late last century, as also today, Australia was very much the poor cousin of New Zealand (Sarma 1986). Both countries lagged well behind both North America, where several extensive floras had been written (Wood 1872; Wolle 1887), and Europe, where, in addition to many floras, the higher classification was being reconsidered (e.g. Rabenhorst 1868; Hansgirg 1886, 1888, 1892) and detailed morphological and life-history studies had commenced (e.g. Pringsheim 1855; Klebs 1892).

The most thoroughly collected area in Australia during that period was Queensland (Bailey 1893, 1895, 1898, 1913). Most algae recorded by Bailey were identified and first published by European phycologists, such as Oskar F. A. Borge (1911), Martin A. J. Möbius (1892, 1895) and Wilhelm Schmidle (1896). The remainder of Australia was left to the sporadic collections of naturalists, phanerogamic botanists or the occasional inland foray of a marine phycologist. Up until recently, no specialist freshwater phycologist had been employed by an Australian or State Government: lately, some universities have supported freshwater algal studies to a limited extent.

The earliest remaining specimens of freshwater algae from Victoria, held in the National Herbarium of Victoria (MEL), were collected by Ferdinand J. H. Mueller soon after he arrived in Melbourne: *Oedogonium*, from ponds near the Yarra River in October 1852; and *Cladophora*, from the Darebin Creek in January 1853. These were identified by Otto W. Sonder and Theodor Reinhold in Europe; Sonder (1852, 1880, 1881) included these genera in his records of algae from Australia. Thirteen years later (Table I), Henry Watts produced the first list of freshwater algae from Victoria.

### Henry Watts (1828–1889)

In the early 1860s, Henry Watts collected marine algae from the drift around Warrnambool and sent them to William Harvey in Ireland (Dueker 1983, 1988). Harvey included these plants in his *Phycologia australica* (1858–1863), naming two species in appreciation of Watts's enthusiasm. Watts also collected freshwater algae from near Warrnambool, and later, Ballarat and the Yarra River basin (mainly the lower reaches of the Yarra River and in the water supply from Yan Yean).

He was interested in all aspects of microscopy. Towards the end of his life, when living in Collingwood, he became involved with the Field Naturalists Club of Victoria (F.N.C.V.) (as librarian, vice-president and committee member), giving talks on various topics of natural history (McCoy 1883). In 1865, Watts published his first list of freshwater algae in the *Trans-*

*actions and Proceedings of the Royal Society of Victoria*. Each record included the names of the waterbody and nearest town. Watts did not give authorities for the names, nor his sources for their identification, but all the desmids can be found in *The British Desmidiaceae* by Ralfs (1848) and the remaining taxa in *The history of the British freshwater algae* by Hassall (1845).

Some of his collections were later given to Mueller, who sent them to Friedrich T. Kützing and C. F. Otto Nordstedt in Europe for identification (Kützing 1882, unpubl.; Nordstedt 1886, unpubl.). Watts published a revised list of freshwater algae in the *Victorian Naturalist* in 1887, this time without any locality details. The names used were from the determinations of Kützing and Nordstedt, or taken from *The freshwater Algae* by Cooke (1884). In the introduction to his 1887 list, Watts mentioned both Cooke (1884), and *A contribution to the history of the freshwater algae* by Wood (1872), as texts he had seen. Hardy (1905) reported that in an unpublished, undated manuscript, Watts stated that he had never seen a species that could not be identified using Ralfs (1848) or Wood (1872).

There were three other publications by Watts that concerned the freshwater algae: a description of a collecting trip to Mt Macedon (Watts 1883), a record of *Oedogonium tenellum* Kützing and associated algae from near Berwick (Watts 1884), and a list of algae found in ponds at Oakleigh (Watts 1886). Again, none of these publications included the source of each identification.

There is little other information available on Henry Watts, and he seems to have died in 1889 without any family or close friends (Death Certificate 1889). His occupation had been reported (Sands & McDougall 1871–1889) as a 'bootmaker', a 'perfume manufacturer', a 'preparer of microscopical objects', and, finally (Inquest Proceedings 1889), as a 'lunatic'. Sadly Watts spent the last year of his life in the Yarra Bend Lunatic Asylum, suffering from dementia and paralysis.

Watts's published legacy consists of two lists of algae and a few scattered records. Although most of his microscopic specimens were lost during his illness (Anon. 1890), some of his algal collections are represented by dry voucher specimens in MEL. None of these, however, has any details of collection beyond a number whose meaning is now obscure (e.g. Fig. 1a). Hardy (1905), felt that the lack of authorities for names detracted from the usefulness of Watts's lists. (Ironically, none of the lists sent by Kützing and Nordstedt to Mueller included authorities, so Watts was not set a good example). Of more importance in a floristic treatment, however, is the basis for each identification, i.e. the literature used and the features considered important. None of this information is given, and specific concepts in some genera vary widely between authors.

The plants in Watts's lists identified by Kützing (Watts coll. nos 3–41, 72–95) and Nordstedt (Watts coll. nos 102–143) can be traced from the letters sent to Mueller. Only 16 of the 42 macroalgal names listed in Watts (1887), however, were provided by these two specialists. So all of the 1865 list, and over half of the 1887 list of macroalgae, were determined using published floras from Europe and America. The circum-

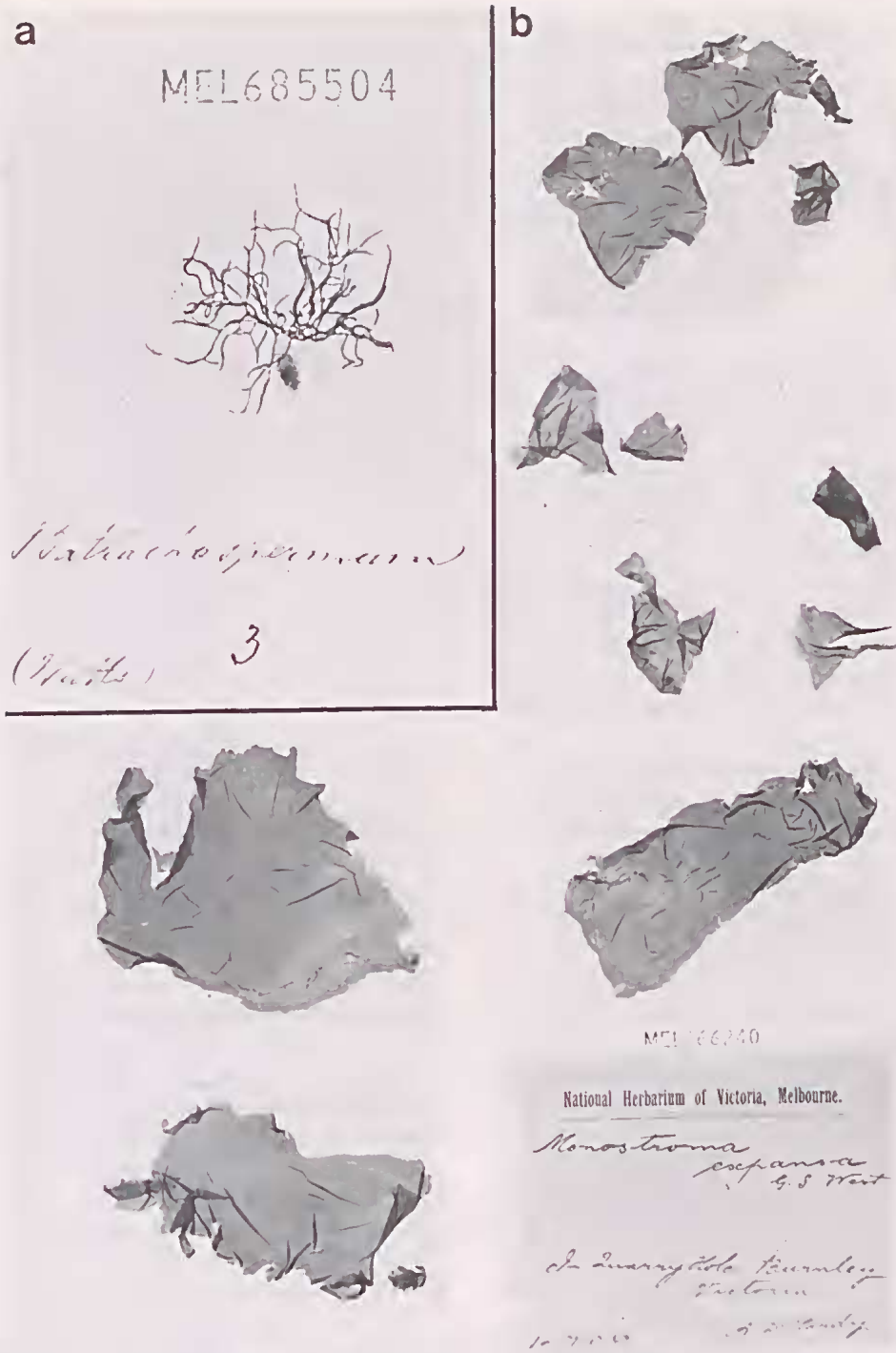


Fig. 1. a — Isotype of *Nothocladus nodosus* Skuja (Watts 3, MEL 685504; x 0.9. b — Syntypes of *Monostroma expansum* West (Hardy s.n., MEL 666240; x 0.4.

scription of species by these early authors (including Kützing and Nordstedt) do not always match current specific concepts (many of Kützing's species of *Spirogyra*, for example, were based on vegetative plants), and there is no indication of how closely Watts followed any taxonomic system.

If preserved material is extant, some identifications can be verified. Of the 21 specimens of macroscopic freshwater algae (excluding Cyanophyta) collected by Watts and held in MEL, only 12 can be tentatively identified to their species. The rest are sterile *Oedogonium*, field material of *Stigeoclonium* and a *Batrachospermum* with poorly preserved reproductive features. Only one, the type of *Nothocladus nodosus* Skuja, was ever fully described and/or illustrated. Watts's collection of slides seems to have been lost or destroyed (Microscopical Group, F.N.C.V., pers.

comm.), and even the parts of it that remained until early this century were not in good condition (Hardy 1905). It seems, therefore, that most of Watts's records for species of macroscopic freshwater algae must be considered useless.

His published records of genera, when supplied with a locality, can probably be accepted due to the comparatively well-defined generic limits of freshwater macroalgae. His record of *Nothocladus nodosus* from the Yarra River in Collingwood is interesting, since the type locality 100 years later is polluted and muddy. To find this species today, one must travel 80 km upstream, to sites with a water quality presumably similar to that found in Collingwood a century ago.

In spite of this lean scientific legacy, Watts should be remembered as the pioneer of freshwater phycology in Victoria. His work with these organisms was hindered

Table I  
Collectors of published records (prior to 1939) of freshwater algae in Victoria\*

Collector	Localities	Published
Mueller, F. J. H. (1825–1896) Watts, H. (1828–1889)	Widespread Warrnambool, Ballarat, Melbourne	Sonder (1852, 1880, 1881), Borge (1896). Watts (1865, 1883, 1884, 1886, 1887), Skuja (1934).
Gibbons, S. (fl. 1868–1869) Shephard, J. (fl. 1890–1903)	Yan Yean, Melbourne Melbourne environs	Gibbons (1874). Shephard (1891, 1896), Shephard <i>et al.</i> (1918a, 1918b).
Berggren, S. (1837–1917) Grayson, H. (fl. 1892–1903) Stickland, W. (fl. 1894–1899)	Fernshaw Ballarat, Geelong, Melbourne Melbourne environs	Nordstedt (1887, 1888). Grayson (1892). W. & J. Stickland (1895, 1896), W. Stickland (1897, 1898), Barnard (1899).
Eekert, I. P. (?J. P. 1861–1924) Lucas, A. H. S. (1853–1936) Smith, W. I. (fl. 1889–1909) Barnes (?-?) Luehmann, J. G. (1843–1904) d'Alton, St E. (fl. 1896–1903) Campbell, F. (fl. 1886–1887) Lauterbach, K. A. G. (1864–1937) Tisdall, H. T. N. (1839–1905) Stickland, J. (fl. 1895–1934)	Wimmera, Murray River Lake Wellington Murray River Ovens River Dandenong Wimmera Australian Alps St Kilda Western Port, Melbourne Melbourne environs	Borge (1896). Borge (1896). Borge (1896). Borge (1896). Borge (1896). Borge (1896). Borge (1896). Schmidle (1897). Tisdall (1898, 1900). W. & J. Stickland (1895, 1896), J. Stickland (1913, 1918, 1920, 1923, 1924, 1929), Shephard <i>et al.</i> (1918b), J. Stickland <i>et al.</i> (1919).
Hardy, A. D. (1870–1958)	Melbourne and surrounds	Hardy (1904a, 1904b, 1905, 1906, 1907, 1910, 1911, 1913, 1936, 1938a, 1938b, 1943), West (1905, 1909). Hardy (1914).
Barnard, F. G. A. (1857–1932) Capra, G. (fl. 1908–1909) Phillipson, J. (fl. 1930–1935)	Mount Baw Baw Daylesford University of Melbourne, Heathmont (terrestrial)	Hardy (1914). De Toni & Forti (1922). Phillipson (1935).

\* Most are isolated records and not comprehensive floras of the localities. There are undoubtedly further incidental records of freshwater algae published by the Field Naturalists Club of Victoria and the Royal Society of Victoria.

by limited assistance from trained phycologists and access to the relevant literature. Nevertheless, he explored the creeks and ponds of Victoria for the first time, and opened the freshwater algal account for Australia.

Few other collections of freshwater algae were made during this period (Table I). In 1868, Sydney Gibbons compared the water quality of the Yan Yean Reservoir with that of Melbourne's drains and sewers. He provided illustrations of the phytoplankton (Gibbons 1874, figs 1–5), and identified a few desmids to species level. In 1875, Sven Berggren collected some macroalgae from in and around the Watts River (named after George Watts, c. 1843, apparently no relation to Henry Watts) at Fernshaw. These were identified by Nordstedt and published with further collections by Berggren from the Blue Mountains (New South Wales) and New Zealand (Nordstedt 1887, 1888). Borge (1896) published a list of algae (some with descriptions and illustrations) sent to him by Mueller. These were primarily collected by naturalists.

There were some incidental records of freshwater algae (mostly microalgae) in the *Victorian Naturalist*, none of which can be verified, and a few collections made in 1899 and 1900 by Richard A. Bastow (1839–1920), held in MEL but not published. Most of the records by the Sticklands (Table I) were incidental in accounts of the animal life in ponds. No major work was done until the start of the next century.

South-eastern Australia was then served by two keen and industrious, honorary phycologists: George I. Playfair in New South Wales (see Tyler & Wiekham 1988), and Alfred D. Hardy in Victoria.

#### Alfred Douglas Hardy (1870–1958)

Alfred Hardy worked with the Forest Commission, mainly as a draftsman and botanical officer, until his retirement in 1936. (A photograph of Hardy will be included in a forthcoming publication by P. A. Tyler & H. U. Ling, University of Tasmania.) Hardy's amateur studies ranged from the tallest trees to the very smallest forms of plant life. The freshwater algae soon became his speciality. In 1909, he was appointed 'honorary algologist' with the Melbourne & Metropolitan Board of Works (M.M.B.W.) and he remained in that position until his death. In later years, however, he did receive 'a fee paid in advance . . . for services rendered' (Hardy 1957, unpubl.).

While working for the M.M.B.W., Hardy produced firstly six-monthly, then quarterly reports on the algae growing in the water bodies controlled by the board. These reports (Hardy 1931–1955, unpubl.) were usually about two pages long, and would include a list of the algae found in the various reservoirs and a summary of conditions at the time. Sometimes simple drawings were included alongside the species listed.

Before being appointed as an honorary algologist with the M.M.B.W., Hardy had already collected from most of the reservoirs around Melbourne. He sent numerous collections to George S. West (1876–1919) in England for identification, and the most interesting of these were described in West (1905) and Hardy (1906). The latter publication included five descriptions supplied by West, two of which were macroalgae (a species of *Monostroma* Thuret and of *Oedogonium*).

In 1909, West published a monumental paper on the

algae from Yan Yean Reservoir: Tyler & Wickham (1988) give a delightful, if romantic, perspective on the microalgae of this focal point for freshwater phycology in Australia. Hardy collected all the algae for this opus. In it, a number of macroalgae from the weedy margin of Yan Yean Reservoir (two species and forms of *Oedogonium*, and one species each of *Ulothrix* Kützing, *Radiofilum* Schmidle, *Mougeotia* C. Agardh, *Debarya* Wittrock and *Zygnema* C. Agardh) were described and illustrated. Five of the macroalgal taxa were new to science including one, *Debarya hardyi* West (1909) named in honour of the collector. Additional macroalgae from nearby creeks and reservoirs were also listed by West. George West has a secure place as a luminary in the history of freshwater algal studies in Victoria, but since his main involvement was with the microalgae and phytoplankton, he is not considered any further here.

Hardy, meanwhile, had included these records and others, mostly from around Melbourne, in his lists of freshwater algae from Victoria (Hardy 1904b, 1905, 1906) and also published on a filamentous alga growing on fish (Hardy 1907, 1910, including a list of algae from the Yarra River, at Kew) and other interesting freshwater algal topics (Hardy 1911, 1913, 1936, 1938a, 1938b, 1943). He gave lectures on freshwater algae (Hardy 1938e) and provided information on collections by himself and other naturalists on excursions (e.g. Hardy 1914, Shephard *et al.* 1918a). In addition, he produced numerous papers on other aspects of natural history (Barnes 1976). All records of algae by Hardy included authorities and approximate localities. Some were described — those that were either new or ‘interesting’ — and a few were also illustrated. For those algae not determined by West, Hardy based his identifications on published descriptions (Hardy 1905, 1906; West 1905). Some of the important literature was supplied by West and Borge (Hardy 1905).

Hardy also had some contact with the University of Melbourne School of Botany. From 1914, Ethel I. McLennan (1891–1983) joined Hardy on some of his collecting trips and helped with identifications. She also provided some access to additional literature. Hardy would later send her material ‘when requested or when the material, in [his] opinion, [was] of sufficient interest’ (Hardy 1931–1955, unpubl.). Iona G. MacLennan (now Christianson) accompanied Hardy on a couple of trips in the 1940s, and some of his final boating days, during 1947–1955, were spent with Sophie C. Ducker.

Hardy, who gave only tentative acceptance to the species determinations of Watts, sought to improve the standard of freshwater algal taxonomy in Victoria. He gave authorities and localities, and tried to obtain a wide range of taxonomic literature. In his own publications, however, we don’t know why he identified most macroalgae as he did: no distinguishing features or precise taxonomic references are given. Of the macroalgae he recorded himself, only a couple were described (by West), and, although a draughtsman by trade, none were illustrated.

Few of Hardy’s collections survive today. There are 99 small vials of formalin preserved material (some of which has dried out) held in West’s collections at the British Museum of Natural History (BM), and a box of

permanent slides is retained in Australia (M.M.B.W.). Most of the algae in these collections have been adequately described by West (Hardy 1906, West 1909). In MEL, there are only three permanent slides of desmids, and a permanent slide and three sheets of dried material of *Monostroma expansa* G. S. West (Hardy 1906; MEL 666239, MEL 666240, MEL 666241). The type material of *M. expansa* (Fig. 1b) is in excellent condition.

Apparently, Hardy felt that only newly described species needed to be well documented and preserved. Yet, few freshwater macroalgae seem to be endemic, and it is their spatial and temporal distribution that is of most scientific interest. So, as with Watts, the records of genera are probably reliable but few specific determinations of macroalgae can be confirmed. In addition, even though Hardy gave localities, some of these are rather vague: e.g. ‘Yarra River’ or ‘Yarra River (backwater)’ for a river system with a catchment of 1,200 km<sup>2</sup>!

Of course, both Watts and Hardy were naturalists with many other interests in life. They collected freshwater algae out of a love of studying the more obscure parts of nature. And so, with no formal training they did an excellent job of collecting plants, naming them and exciting the interest of their colleagues. The problem, however, is that they provide almost the sole legacy of freshwater algal study in Victoria. From this point of view, they did not leave a particularly solid foundation for the future.

There was no rush to build on even these shaky foundations (Table 1). Besides a report (De Toni & Forti 1922) on some algae found early in the century, and a study of soil algae by Phillipson (1935), there were no published records of new collections until after 1939. The next reports came from Cookson (1953), who studied Cainozoic deposits, and Ducker (1958), who found a new species of *Basicleadia* Hoffman & Tilden on the back of turtles. A collection from last century, however, had been re-examined by the Latvian phycologist Heinrichs L. Skuja; the results were published in 1934, while Hardy was still in his phycolgical prime.

#### Heinrichs Leonhards Skuja (1892–1972)

Heinrichs Skuja was a distinguished European specialist on freshwater algae who worked in Riga, and later Uppsala (Thomasson 1974, includes photograph of Skuja). His descriptions and drawings of species were always meticulous, leaving no doubt as to the plants he saw. Skuja wanted to revise the freshwater Rhodophyta, and was sent collections from throughout the world (Willén 1979). He lost most of his early collections when he fled from Latvia to Sweden in a small open boat during the second world war (F. Ott, pers. comm. July 1981). At the time of his death, Skuja had completed little of this monograph.

Skuja gave many manuscript names to specimens, but only a few were formally described. Australian and New Zealand herbaria hold a number of Skuja’s *nomina nuda*: Cassie (1984) lists 4 species and one variety of *Batrachospermum* from New Zealand which are Skuja *nomina nuda* or *nomina dubia*. Luckily, Skuja (1934) published his description and illustration of a specimen examined from MEL, now at Botanischer Garten und Botanisches Museum Berlin-Dahlem (B),

as a new genus and species, *Nothocladus nodosus*. This was based on the material collected by Watts in 1884, from the Yarra River, Collingwood.

Skuja (1934) described a second species in that genus, *N. tasmanicus*, from a specimen collected in Cataract River, Launceston, Tasmania, and held at the Herbarium, Royal Botanic Gardens (K). The plants originally had been identified as *Batrachospermum vagum* Sirodot by Harvey (1860). Subsequently, *N. tasmanicus* has been placed in synonymy with *N. nodosus* (Entwisle & Kraft 1984). No other descriptions of Australian algae by Skuja were ever published, although he received a number of specimens from Tasmania in 1968–1970, collected by Dr Peter Tyler (Skuja 1968–1970, unpubl.), and from many Australian herbaria (e.g. MEL, HO, ADU).

With most freshwater algae, an accurate illustration and description are far more valuable than the type for understanding the plant on which a name is based. Observations on freshly collected material, or plants preserved in liquid, are usually essential. Yet, Skuja's description and illustration of *Nothocladus nodosus* were made from a 50-year-old dried specimen. Kützing (1882, unpubl.) described the same specimen as perhaps a new species of *Batrachospermum*, but in a state of deterioration. So we have Watts to thank for the voucher specimen, and Skuja, for his phytographic skills. Thankfully, the important taxonomic features remained intact in this dry preserved specimen.

### Conclusions

There must be at least one feature of the floristic legacy that I proposed at the beginning of this paper, for a record to be of any scientific value. Watts has left mostly incompletely labelled voucher specimens, and his published records are inadequate. Hardy left a voucher specimen for only one of his macroalgae, and only rarely provided adequate published evidence for his determinations. West, however, immortalized some of his earlier records of macroalgae. Skuja didn't collect here, but provided a classic taxonomic account of one species from Victoria. The other *nomina nuda*, of course, detract from his record. Overall, one might have hoped for more.

The legacy of freshwater phycology in Victoria is certainly lean. The pickings of macroscopic algae are few: some historically interesting generic records and a handful of taxa well described and illustrated. The bulk of the state is still to be explored for freshwater algae.

Effectively, all studies on freshwater macroalgae from Victoria start with an almost clean slate. This is both exciting and saddening. In the last 10 years there has been renewed interest in the freshwater algae of Victoria (Foged 1978; Chessman 1982, 1985a, 1985b, 1986a, 1986b; Entwisle & Kraft 1984; Christensen 1986, 1987; Entwisle 1987, 1988a, 1988b, 1989; Tyler & Wickham 1988). One can only hope that the scientific legacy currently accruing is better appreciated in 50 years time.

Finally, there is a legacy that should not be overlooked. Hardy's neighbours and friends will long remember him entertaining and teaching them microscopy on his front porch in Kew, where, for many, the discovery of freshwater algae really began.

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